

## CLAIMS

- 1 A branched polymer comprising an acrylic copolymer comprising one or more core arm(s) comprising one or more core polymer(s) and one or more shell arm(s) comprising one or more shell polymer(s) where said acrylic copolymer is obtained and/or obtainable by (optionally metal catalysed) radical polymerization and has a polydispersity of from about 3 to about 10, and where (a) the or each core polymer(s) has a polydispersity of at least about 2 and a  $T_g$  of from about  $-65^{\circ}\text{C}$  to about  $-20^{\circ}\text{C}$ , and (b) the or each shell polymer(s) has a  $T_g$  of from about  $70^{\circ}\text{C}$  to about  $160^{\circ}\text{C}$ .
- 2 A branched polymer as claimed in claim 1, which is a star shaped thermoplastic elastomer acrylic block copolymer with a theoretical number average molecular weight ( $M_n$ ) of greater than 100 kilo daltons obtained by transition metal catalysed radical polymerization
- 3 A copolymer as claimed in either preceding claim which is substantially free of a region obtained by an amine functional ethylenically unsaturated radically polymerisable monomer.
- 4 A copolymer according to any preceding claim, which is obtained or obtainable by transition metal catalysed radical polymerisation.
- 5 A copolymer according to any preceding claim, in which the core arms have a  $M_n$  of from about 60 to about 250 kilodaltons, and the shell arms have an  $M_n$  of from about 20 to about 80 kilodaltons.
- 6 A copolymer according to any preceding claim, wherein the mass percentage of shell arms in the copolymer is from about 10% to about 50%.
- 7 A copolymer according to any preceding claim, wherein the polymer precursors from which the all or a part of the core arms are obtained or obtainable are selected from the following monomers:  $\text{C}_{1-10}$ alkyl acrylates, amyl acrylates, stearyl acrylate, lauryl acrylates and/or mixtures and/or derivatives thereof.
- 8 A copolymer according to claim 7, where the monomers are selected from methyl acrylate, ethyl acrylate, n-propyl acrylate, isopropyl acrylate, n-butyl acrylate, tert.-butyl acrylate, sec.-butyl acrylate, isobutyl acrylate, amyl acrylate, hexyl acrylate,

2-ethylhexyl acrylate, octyl acrylate, nonyl acrylate, decyl acrylate, stearyl acrylate, lauryl acrylate and/or mixtures thereof.

9 A copolymer according to claim 8, wherein the monomers are selected from  
5 methyl methacrylate, ethyl methacrylate, tert.-butyl acrylate, cyclohexyl methacrylate, isobornyl methacrylate and/or mixtures thereof.

10 A copolymer according to any preceding claim, wherein the core and/or the  
shell arms further comprise polymeric moieties obtained and/or obtainable from one or  
10 more monomers selected from glycidyl methacrylate, tert-butyl (meth)acrylate, hydroxy (meth)acrylates, styrene and/or mixtures and/or derivatives thereof.

11 A method for producing a branched polymer according to any preceding claim,  
the method comprising the steps of:

15 (a) mixing (i) a polymerisation initiator (ii) one or more first acrylate polymer precursor(s); (iii) a ligand (optionally an amine); and (iv) an metal catalyst (optionally a transition metal salt and/or complex); to form a reaction mixture:

where at least one of the polymerisation initiator and/or first acrylate polymer precursor(s) comprise at least three active functionalities  
20 capable of reacting to form polymeric core arms;

(b) polymerising the polymer precursor(s) in the reaction mixture until at least about 91% of the total weight of the polymer precursor(s) have been polymerised; to produce an acrylate polymer comprising polymeric core arms;

(c) adding to the reaction mixture, without any purification thereof, one or more  
25 second acrylate polymer precursor(s) capable of forming polymeric shell arms;

(d) polymerising the further polymer precursors to produce an acrylate copolymer comprising polymeric shell arms until: (i) at least about 95% of the total weight of the second polymer precursor(s) has been polymerised: and/or (ii) the  $M_n$  of at least one of the arm(s) of the shell polymer reaches at least about 5  
30 kilodaltons (preferably at least about 7 kilo-datons);

(e) collecting and purifying the copolymer from the reaction mixture.

12. A method as claimed in claim 11, in which in step (b) greater than about 95% by weight of the polymer precursor(s) are polymerised.

13. A method as claimed in either claim 11 or 12, in which after step (d) the copolymer is hydrolysed (optionally by heating in acrylic acid) to remove any tert-butyl acrylate groups which may be present in the core and/or shell arms.
- 5 14. A method as claimed in any of claims 11 to 13, which produces a multi-phase mixture of acrylate copolymers having one or more core arm(s) with acrylate polymers having one or more shell arm(s).
- 10 15. A method as claimed in any of claims 11 to 14, which produces acrylate copolymers having core and shell arms on the same polymeric chain.
- 15 16. A method as claimed in any of claims 11 to 15, where the transition metal complex is a catalyst for atom transfer radical polymerisation and comprises at least one metal complex of copper(I).
17. A method as claimed in any of claims 11 to 16, where Cu(0) is also added to the reaction mixture.
- 18 A method as claimed in any of claims 11 to 17, where the copolymer is purified  
20 by adding a non-solvent of the copolymer to the reaction mixture.
- 19 A method as claimed in any of claims 11 to 17, where the copolymer is purified  
by super-critical CO<sub>2</sub> extraction in presence of a polar cosolvent.
- 25 20 An adhesive composition comprising a branched copolymer as claimed in any  
of claims 1 to 10.
- 21 An adhesive as claimed in claim 20, which further comprises from about 5 to  
about 150 phr of a tackifier, calculated by the weight of the copolymer.
- 30 22 An adhesive as claimed in claim 21 which comprises from about 25 to about  
150 phr of a tackifier.
- 23 An adhesive as claimed in any of claims 20 to 22 which is a pressure sensitive  
35 adhesive or a hot-melt adhesive.

24. A composition comprising two or more incompatible acrylic polymers together with as a compatibilising agent one or more polymers as claimed in any of claims 1 to 10.
- 5 25. Use of a polymer as claimed in any of claims 1 to 10 as a compatibilising agent for two or more incompatible acrylic polymers.